

WHAT IS CLAIMED IS:

- 1 1. An electrosurgical probe, comprising:
2 an active electrode terminal disposed at the probe distal end;
3 a fixed return electrode spaced from the active electrode terminal;
4 and
5 a movable return electrode configured to move with respect to the
6 active electrode terminal between a first location and a second location.
7
- 1 2. The probe of claim 1, wherein the movable return electrode is
2 configured to move linearly with respect to the active electrode terminal.
3
- 1 3. The probe of claim 1, further comprising a shaft and a push
2 rod, a proximal portion of the push rod disposed internal to the shaft, and the push
3 rod movable linearly with respect to the shaft.
4
- 1 4. The probe of claim 3, further comprising an electrically
2 insulating sleeve disposed on at least a proximal portion of the push rod, wherein
3 the movable return electrode comprises an exposed distal portion of the push rod.
4
- 1 5. The probe of claim 3, wherein the push rod comprises a metal
2 cylinder or a metal rod.
3
- 1 6. The probe of claim 1, further comprising a shaft having a
2 shaft distal end and a shaft proximal end, wherein the active electrode terminal
3 extends distally from the shaft distal end.
4
- 1 7. The probe of claim 6, further comprising:
2 a first electrically insulating spacer extending distally from the shaft
3 distal end, the fixed return electrode disposed distal to the first spacer; and
4 a second electrically insulating spacer extending distally from the first
5 spacer.
6

1 8. The probe of claim 7, wherein the first spacer spaces the
2 movable return electrode from the fixed return electrode.

1 9. The probe of claim 7, wherein the first spacer comprises a
2 plastic tube having at least one lumen therein.

1 10. The probe of claim 7, wherein the second spacer extends
2 distal to the fixed return electrode.

1 11. The probe of claim 7, wherein the second spacer comprises a
2 material selected from the group consisting of a ceramic, a silicone rubber, a
3 polyimide, a fluoro-polymer and a glass.

1 12. The probe of claim 7, wherein the second spacer comprises
2 alumina.

1 13. The probe of claim 6, wherein the movable return electrode is
2 configured to move in a direction substantially parallel to the longitudinal axis of the
3 shaft.

1 14. The probe of claim 6, wherein, in the first location, the
2 movable return electrode is retracted proximally within the shaft.

1 15. The probe of claim 1, wherein, in the second location, the
2 movable return electrode lies adjacent to the active electrode terminal.

1 16. The probe of claim 1, wherein the first location comprises a
2 proximal location of the movable return electrode and the second location comprises
3 a distal location of the movable return electrode, and wherein the distal location
4 defines a closed configuration of the probe, and the proximal location defines an
5 open configuration of the probe.

1 17. The probe of claim 16, wherein, in the closed configuration,
2 the probe is adapted for clamping a target tissue between a distal end of the movable
3 return electrode and the active electrode terminal.

1 18. The probe of claim 16, wherein, in the closed configuration,
2 the probe is adapted for compressing and coagulating a blood vessel between a distal
3 end of the movable return electrode and the active electrode terminal.

1 19. The probe of claim 16, wherein, in the open configuration, a
2 first current path exists between the active electrode terminal and the fixed return
3 electrode.

1 20. The probe of claim 19, wherein, in the closed configuration, a
2 second current path between the active electrode terminal and the movable return
3 electrode is shorter than the first current path between the active electrode terminal
4 and the fixed return electrode.

1 21. The probe of claim 16, wherein, in the closed configuration, a
2 gap exists between the movable return electrode and the active electrode terminal.

1 22. The probe of claim 1, further comprising an actuator unit for
2 moving the movable return electrode between the first location and the second
3 location.

1 23. The probe of claim 22, further comprising a handle, wherein
2 the actuator unit is mounted on the handle.

1 24. The probe of claim 1, wherein the movable return electrode
2 distal end is circular or semicircular in cross-section.

1 25. The probe of claim 1, wherein the movable return electrode
2 distal end is beveled at an angle of about 45°.

3
1 26. The probe of claim 1, wherein the active electrode terminal
2 comprises a material selected from the group consisting of platinum, molybdenum,
3 tungsten, palladium, iridium, titanium, stainless steel and their alloys.
4

1 27. The probe of claim 1, wherein the active electrode terminal
2 comprises a hook.
3

1 28. The probe of claim 27, wherein the hook comprises an arm
2 and a crosspiece.
3

1 29. The probe of claim 28, wherein the crosspiece is arranged at
2 an angle of about 90° with respect to the arm.
3

1 30. The probe of claim 28, wherein the crosspiece is arranged at
2 an angle of about 45° with respect to the arm.
3

1 31. The probe of claim 28, wherein the crosspiece includes a first
2 side, a second side, a distal face, and a proximal face, and wherein at least the
3 proximal face is adapted for electrosurgically cutting tissue.
4

1 32. The probe of claim 1, wherein the active electrode terminal
2 comprises a flattened wire.
3

1 33. The probe of claim 1, wherein the active electrode terminal
2 comprises a first arm and a second arm juxtaposed with the first arm, and a
3 crosspiece emanating from the first and second arms.
4

1 34. The probe of claim 33, wherein each of the first arm and the
2 second arm comprise a round wire.
3

1 35. The probe of claim 33, wherein the crosspiece comprises a
2 first branch and a second branch, the first branch and the second branch spaced
3 apart to define a window therebetween, wherein the window tapers from broad to
4 narrow in a direction away from the first and second arms.
5

1 36. The probe of claim 35, wherein the window comprises an
2 elongated void having a first width at a location adjacent to the first and second
3 arms in the range of from about 0.010 inch to 0.050 inch.
4

1 37. The probe of claim 36, wherein the window tapers to a second
2 width in the range of from about 0.005 inch to 0.020 inch.
3

1 38. The probe of claim 35, wherein the window is adapted for
2 receiving and retaining a liquid therein.
3

1 39. The probe of claim 35, wherein the window is adapted for
2 transporting a liquid therein via capillary action.
3

1 40. The probe of claim 35, wherein the first branch and the
2 second branch comprise a shaped wire.
3

1 41. The probe of claim 40, wherein the shaped wire is folded to
2 form an apical portion of the crosspiece.
3

1 42. The probe of claim 40, wherein the first branch and the
2 second branch each have at least two contiguous planar surfaces.
3

1 43. The probe of claim 7, wherein the active electrode terminal
2 extends distally from the second spacer.
3

1 44. The probe of claim 1, wherein the fixed return electrode
2 comprises a wire coil.

3
1 45. The probe of claim 1, wherein the fixed return electrode
2 comprises a material selected from the group consisting of platinum, molybdenum,
3 tungsten, palladium, iridium, titanium, and their alloys.
4

1 46. The probe of claim 6, further comprising a multi-lumen tube
2 disposed within the shaft.
3

1 47. The probe of claim 46, wherein the multi-lumen tube includes
2 an active electrode lumen, and the probe further includes an electrically insulating
3 spacer protruding distally from the active electrode lumen.
4

1 48. The probe of claim 46, wherein the multi-lumen tube
2 comprises a plastic extrusion product.
3

1 49. The probe of claim 46, wherein the multi-lumen tube includes
2 at least three lumina.
3

1 50. The probe of claim 46, wherein the multi-lumen tube includes
2 a fluid delivery lumen for delivering an electrically conductive fluid to the shaft
3 distal end, and wherein the multi-lumen tube further includes as aspiration lumen for
4 aspirating unwanted or excess materials from the vicinity of the shaft distal end.
5

1 51. The probe of claim 46, wherein the multi-lumen tube includes
2 a return electrode lumen, and a proximal portion of the return electrode lies within
3 the return electrode lumen.
4

1 52. The probe of claim 46, wherein the multi-lumen tube extends
2 distally from the shaft distal end by a distance in the range of from about 0.3 inch to
3 2.5 inches.
4

1 53. The probe of claim 6, further comprising a handle affixed to
2 the shaft proximal end, the handle housing a connection block, the active electrode
3 terminal coupled to the connection block, wherein the connection block is adapted
4 for electrically coupling the active electrode terminal to a first pole of a high
5 frequency power supply.

1 54. The probe of claim 53, wherein the fixed return electrode and
2 the movable return electrode are coupled to the connection block, and the
3 connection block is adapted for electrically coupling the fixed return electrode and
4 the movable return electrode to a second pole of the high frequency power supply.

1 55. The probe of claim 53, wherein the fixed return electrode is
2 coupled to the connection block, and the movable return electrode is adapted for
3 alternating between being coupled to the connection block and being uncoupled from
4 the connection block.

1 56. The probe of claim 55, further comprising a contact unit in
2 communication with the connection block and with the movable return electrode, the
3 contact unit adapted for coupling and uncoupling the movable return electrode to the
4 connection block.

1 57. The probe of claim 56, wherein, in the first location, the
2 movable return electrode is electrically uncoupled from the connection block, and
3 wherein, in the second location, the movable return electrode is electrically coupled
4 to the connection block.

1 58. The probe of claim 6, wherein the shaft is electrically
2 insulating.

1 59. The probe of claim 1, further comprising a fluid delivery unit
2 for delivering a fluid to the probe distal end.

1 60. The probe of claim 59, wherein the fluid delivery unit
2 includes a fluid delivery lumen, the fluid delivery lumen internal to the shaft.
3

1 61. The probe of claim 59, further comprising an aspiration unit
2 for aspirating unwanted materials from the vicinity of the distal end of the probe.
3

1 62. The probe of claim 61, wherein the aspiration unit includes an
2 aspiration lumen, the aspiration lumen internal to the shaft.
3

1 63. The probe of claim 7, wherein the active electrode terminal
2 extends distally from the second spacer by a distance in the range of from about 0.1
3 mm to about 10 mm.
4

1 64. The probe of claim 1, wherein in the first location the
2 movable return electrode lies proximal to the fixed return electrode, and in the
3 second location, the movable return electrode lies distal to the fixed return
4 electrode.

1 65. The probe of claim 1, wherein the fixed return electrode is
2 disposed proximal to the active electrode terminal.

1 66. An electrosurgical probe, comprising:
2 a shaft having a shaft distal end and a shaft proximal end;
3 a first electrically insulating spacer disposed at the shaft distal end;
4 a fixed return electrode disposed at a distal end of the first spacer;
5 a second electrically insulating spacer extending distally from the
6 fixed return electrode;

7 an active electrode terminal disposed at the distal end of the second
8 spacer; and

9 a movable return electrode configured to move with respect to the
10 active electrode terminal between a proximal location and a distal location.
11

1 67. The probe of claim 66, wherein the movable return electrode
2 is configured to move linearly in a direction substantially parallel to the longitudinal
3 axis of the shaft.
4

1 68. The probe of claim 66, further comprising an actuator unit for
2 moving the movable return electrode between the proximal location and the distal
3 location.
4

1 69. The probe of claim 66, further comprising a push rod movable
2 in a direction substantially parallel to the longitudinal axis of the shaft, wherein the
3 movable return electrode is disposed at a distal end of the push rod.
4

1 70. The probe of claim 69, wherein the push rod comprises an
2 electrically conducting material, at least a proximal portion of the push rod
3 ensheathed within an electrically insulating sleeve, and wherein the movable return
4 electrode comprises an exposed distal portion of the push rod.
5

1 71. The probe of claim 69, wherein at least a proximal portion of
2 the push rod lies internal to the shaft, and wherein, in the proximal location, the
3 movable return electrode is entirely retracted within the shaft.
4

1 72. The probe of claim 66, wherein the proximal location defines
2 an open configuration of the probe, and wherein the open configuration of the probe
3 is adapted for electrosurgically cutting or ablating a target tissue or organ.
4

1 73. The probe of claim 66, wherein, in the distal location, the
2 movable return electrode lies adjacent to the active electrode terminal.
3

1 74. The probe of claim 73, wherein the distal location defines a
2 closed configuration of the probe, and in the closed configuration the probe is
3 adapted for coagulating and occluding a blood vessel.
4

1 75. The probe of claim 66, wherein the active electrode terminal
2 comprises a crosspiece, the crosspiece having a distal face and a proximal face.
3

1 76. The probe of claim 75, wherein the proximal face is adapted
2 for clamping a blood vessel against a distal end of the movable return electrode.
3

1 77. The probe of claim 66, wherein the active electrode terminal
2 comprises a shaped wire having at least one substantially planar surface.
3

1 78. The probe of claim 66, wherein, in a closed configuration of
2 the probe, a first current path between the active electrode terminal and the fixed
3 return electrode is longer than a second current path between the active electrode
4 terminal and the movable return electrode.
5

1 79. The probe of claim 78, wherein, in the closed configuration, a
2 high current density exists between the active electrode terminal and the movable
3 return electrode.
4

1 80. An electrosurgical probe, comprising:
2 a shaft having a shaft distal end and a shaft proximal end;
3 an active electrode terminal disposed at the shaft distal end;
4 a fixed return electrode disposed proximal to the active electrode
5 terminal; and
6 a movable return electrode configured to move linearly with respect
7 to the active electrode terminal between a proximal location and a distal location,
8 wherein the proximal location defines an open configuration of the probe and the
9 distal location defines a closed configuration of the probe.
10

1 81. The probe of claim 80, wherein, in the open configuration,
2 the movable return electrode is retracted proximally within the shaft, and wherein
3 the open configuration is adapted for severing a target tissue or an organ.
4

1 82. The probe of claim 80, wherein, in the open configuration,
2 the movable return electrode is electrically disengaged from the probe.
3

1 83. The probe of claim 80, wherein, in the closed configuration,
2 the movable return electrode lies adjacent to the active electrode terminal, and
3 wherein the closed configuration is adapted for clamping and coagulating a blood
4 vessel.
5

1 84. The probe of claim 80, further comprising a multi-lumen tube
2 disposed longitudinally within the shaft, the active electrode terminal emanating
3 from a first lumen of the multi-lumen tube, and the fixed return electrode emanating
4 from a second lumen of the multi-lumen tube.
5

1 85. An electrosurgical probe, comprising:
2 a shaft having a shaft distal end and a shaft proximal end;
3 a multi-lumen tube disposed longitudinally within the shaft;
4 an active electrode terminal extending distally from a first lumen of
5 the multi-lumen tube;
6 a fixed return electrode emanating from a second lumen of the multi-
7 lumen tube; and
8 a movable return electrode configured to move with respect to the
9 active electrode terminal between a proximal location and a distal location.
10

1 86. The probe of claim 85, wherein in the proximal location the
2 movable return electrode lies proximal to the fixed return electrode, and in the distal
3 location, the movable return electrode lies distal to the fixed return electrode.
4

1 87. The probe of claim 85, wherein the fixed return electrode
2 comprises a coil of wire.
3

1 88. The probe of claim 85, further comprising a push rod movable
2 linearly with respect to the shaft, wherein the movable return electrode is disposed
3 at the push rod distal end.
4

1 89. The probe of claim 88, wherein the push rod comprises a
2 metal rod or a metal cylinder.
3

1 90. The probe of claim 89, wherein at least a proximal portion of
2 the push rod is ensheathed within an electrically insulating sleeve, and the movable
3 return electrode comprises an exposed, distal portion of the push rod.
4

1 91. The probe of claim 85, wherein current flow shifts from a
2 first current flow path to a second current flow path as the movable return electrode
3 approaches the active electrode, wherein the first current flow path is from the
4 active electrode to the fixed return electrode and the second current flow path is
5 from the active electrode to the movable return electrode.
6

1 92. The probe of claim 85, further comprising an electrically
2 insulating spacer extending distally from the fixed return electrode, wherein the
3 spacer is affixed within a distal portion of the first lumen, the spacer having a bore
4 therethrough, and the active electrode terminal emanating from the bore of the
5 spacer.
6

1 93. The probe of claim 85, wherein the multi-lumen tube includes
2 a fluid delivery lumen and an aspiration lumen.
3

1 94. An electrosurgical system, comprising:
2 an electrosurgical probe configurable between an open configuration
3 and a closed configuration, the probe including a shaft having a shaft distal end, an
4 active electrode terminal disposed at the shaft distal end, a fixed return electrode
5 disposed proximal to the active electrode terminal, and a movable return electrode

6 configured to move linearly with respect to the active electrode terminal between the
7 open configuration and the closed configuration; and

8 a high frequency power supply, the active electrode terminal coupled
9 to a first pole of the high frequency power supply, the fixed return electrode and the
10 movable return electrode coupled to a second pole of the high frequency power
11 supply, the high frequency power supply adapted for applying a high frequency
12 voltage between the active electrode terminal and at least one of the fixed return
13 electrode and the movable return electrode.

14
1 95. The system of claim 94, wherein, in the open configuration,
2 the movable return electrode is mechanically disengaged from the active electrode
3 terminal.

4
1 96. The system of claim 94, wherein, in the open configuration,
2 the movable return electrode is electrically uncoupled from the high frequency
3 power supply.

4
1 97. The system of claim 94, wherein the system further includes a
2 fluid delivery unit for delivering an electrically conductive fluid to the shaft distal
3 end, and wherein in the open configuration the fixed return electrode serves as a
4 primary current path between the active electrode and the power supply.

5
1 98. The system of claim 97, wherein in the closed configuration
2 the movable return electrode provides the primary current path between the active
3 electrode and the power supply.

4
1 99. A method for electrosurgically treating a target tissue of a
2 patient, comprising:

3 a) providing an electrosurgical probe, the probe configurable between
4 an open configuration and a closed configuration, the probe including an active
5 electrode terminal, a fixed return electrode disposed proximal to the active electrode
6 terminal, and a movable return electrode configured to move linearly with respect to

7 the active electrode terminal between the open configuration and the closed
8 configuration;

9 b) positioning the active electrode terminal in at least close proximity
10 to the target tissue; and

11 c) applying a high frequency voltage between the active electrode
12 terminal and at least one of the fixed return electrode and the movable return
13 electrode, wherein at least a portion of the target tissue is ablated or modified.
14

1 100. The method of claim 99, further comprising:

2 d) prior to said step c), configuring the probe to the open
3 configuration or to the closed configuration.
4

1 101. The method of claim 99, wherein said step c) comprises
2 applying a sub-ablation voltage while the probe is in the closed configuration.
3

1 102. The method of claim 101, wherein the sub-ablation voltage is
2 in the range of from about 10 volts RMS to 150 volts RMS.
3

1 103. The method of claim 99, wherein said step c) comprises
2 applying an ablation voltage while the probe is in the open configuration.
3

1 104. The method of claim 103, wherein the ablation voltage is in
2 the range of from 200 volts RMS to 1000 volts RMS.
3

1 105. The method of claim 97, wherein the probe further comprises
2 a shaft, and a multi-lumen tube lying internal to the shaft, the multi-lumen tube
3 including a fluid delivery lumen, the active electrode terminal disposed at the shaft
4 distal end, and the method further comprising:

5 e) via the fluid delivery lumen, delivering an electrically conductive
6 fluid to the shaft distal end or to the target site.
7

106. The method of claim 99, wherein the ablated or modified target tissue is dissected, transected, incised, severed, coagulated, or contracted.

107. A method for severing tissue at a target site, comprising:

a) positioning an active electrode terminal of an electrosurgical probe at the target site within or on a patient, the probe comprising a fixed return electrode and a movable return electrode;

b) applying an ablation voltage between the active electrode terminal and the fixed return electrode, the ablation voltage sufficient to ablate the tissue at the target site;

c) moving the movable return electrode to a position adjacent the tissue; and

d) applying a sub-ablation voltage between the active electrode terminal and the movable return electrode, the sub-ablation voltage sufficient to coagulate or otherwise modify the tissue.

108. The method of claim 107, further comprising:

e) during said step b), translating the active electrode terminal with respect to the tissue.

109. The method of claim 108, wherein the active electrode terminal comprises an arm and a crosspiece, the crosspiece having a proximal face and a distal face, at least one of the proximal face and the distal face adapted for severing the tissue, and wherein said step e) comprises translating the crosspiece with respect to the tissue, wherein the tissue is severed.

110. The method of claim 108, wherein said step e) comprises engaging the proximal face of the crosspiece against the tissue and drawing the active electrode terminal in a proximal direction.

111. The method of claim 107, further comprising:

f) prior to said step b), delivering an electrically conductive fluid to the

probe distal end or to the tissue, wherein the electrically conductive fluid provides a current flow path between the active electrode terminal and at least one of the fixed return electrode and the movable return electrode.

112. The method of claim 107, further comprising:

g) aspirating unwanted materials from the vicinity of the probe distal end.

113. The method of claim 107, wherein the ablation voltage applied in said step b) is a high frequency voltage in the range of from about 200 volts RMS to 1000 volts RMS.

114. The method of claim 107, wherein the sub-ablation voltage applied in said step d) is a high frequency voltage in the range of from about 10 volts RMS to 150 volts RMS.

115. The method of claim 107, wherein the tissue comprises connective tissue.

116. The method of claim 107, wherein the probe is configurable between an open configuration and a closed configuration, the fixed return electrode is disposed proximal to the active electrode terminal, and the movable return electrode is configured to move linearly with respect to the active electrode terminal between the open configuration and the closed configuration, and wherein said step c) comprises moving the movable return electrode linearly with respect to the active electrode terminal.

117. The method of claim 116, further comprising:

i) upon encountering a blood vessel, clamping the blood vessel by the probe; and

j) while the blood vessel remains clamped according to said step i), applying the sub-ablation voltage of said step d) between the active electrode

terminal and the movable return electrode, whereby the blood vessel walls are electrosurgically welded together to provide an occluded blood vessel.

118. The method of claim 117, wherein said step i) comprises physically compressing the blood vessel, whereby blood flow through the vessel is stopped.

119. The method of claim 117, wherein the occluded vessel is formed by cross-linking collagen fibers within the walls of the blood vessel.

120. The method of claim 117, wherein said step i) comprises configuring the probe from the open configuration to the closed configuration.

121. The method of claim 117, wherein the active electrode terminal comprises an arm and a crosspiece, the crosspiece having a proximal face, and wherein said step i) comprises clamping the blood vessel between the proximal face of the crosspiece and a distal end of the movable return electrode.

122. A method for severing a blood vessel during a surgical procedure, comprising:

a) providing an electrosurgical probe, the probe configurable between an open configuration and a closed configuration, the probe including an active electrode terminal, a fixed return electrode disposed proximal to the active electrode terminal, and a movable return electrode configured to move linearly with respect to the active electrode terminal between the open configuration and the closed configuration;

b) clamping a blood vessel between the active electrode terminal and the movable return electrode such that the blood vessel is compressed, wherein the probe is configured in the closed configuration;

c) applying a sub-ablation voltage between the active electrode terminal and at least the movable return electrode, the sub-ablation voltage sufficient to electrosurgically weld the blood vessel, wherein the blood vessel is occluded;

15 d) configuring the probe to the open configuration; and
16 e) applying an ablation voltage between the active electrode terminal
17 and at least the fixed return electrode, the ablation voltage sufficient to
18 electrosurgically sever the occluded blood vessel.

19
1 123. The method of claim 122, wherein current flow shifts from a
2 first current flow path to a second current flow path as the probe is configured from
3 the open configuration to the closed configuration, wherein the first current flow
4 path is from the active electrode to the fixed return electrode and the second current
5 flow path is from the active electrode to the movable return electrode.

6
1 124. The method of claim 123, wherein current flow shifts from
2 the first current flow path to the second current flow path as the movable return
3 electrode approaches the active electrode.